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Evolution Now

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BOOK REVIEW

Evolution Now, by David Penny, Bloomington, IN, XLibris, 2017. 226 pp, US$47.46 (hardback). ISBN 9781499099317

Professor David Penny is a doyen of New Zealand science, an internationally recognised, highly awarded and highly cited, theoretical and molecular biologist who has had a life-long fascination with evolution. Those with an interest in his career can find a wide range of commentaries, pertinent scientific contributions and reminiscences in a special issue of *New Zealand Science Review* (Petrey 2009).

Evolution Now is David Penny through-and-through. His curiosity and slightly irreverent mischievousness emerge from the pages in equal measure. He begins the book by laying out his philosophical underpinnings: the first sentence of the Preface states that: 'This book is written from a Popperian perspective'. Penny goes on to explain that he was steeped in Karl Popper's philosophy of science—the importance of falsifying hypotheses—during his undergraduate training at Canterbury University some years after Popper had left that institution. Although 'falsificationism' has been criticised in philosophical circles, it remains influential and Penny returns to this theme again and again—as scientists, and in order to progress science, we must always test our hypotheses and seek to falsify them.

The bulk of the book falls into three sections: chapters 1–4 describe the history of evolutionary theory; chapters 5–7 discuss particular areas of evolutionary research of interest to Penny; chapter 8 poses unanswered questions.

The main text starts with an examination of some precursors to Darwin's theory of evolution by natural selection. Penny's narrative essentially starts in the seventeenth century, though with short forays into earlier thinking. Although somewhat arbitrary, this starting point charts the change of European thinking from belief in the spontaneous generation of life forms to belief in unitary and unique creation of species. This historical survey continues in chapter 2, and covers key European players in the eighteenth century, including James Hutton, Charles Lyell, Georges Cuvier and, of course, Charles Darwin. As a geologist and paleontologist myself, it is nice to see acknowledgement that Darwin was, first and foremost, a geologist. In this chapter, as elsewhere, Penny injects thought-provoking asides, such as the difference between the concepts of 'actualism' and the more widely, but probably inappropriately, used 'uniformitarianism'.

Chapter 3 analyses Darwin's theory of evolution by natural selection. In particular, I found the presentation of 20 key points on this topic valuable and somewhat different from accounts I've read elsewhere. I take slight issue with Penny's caricature of the important work by Eldredge & Gould (1972), where they argued for bursts of rapid evolution within an evolving lineage, separated by long periods of little or no evolution—termed stasis. One of their key observations, ignored by Penny, is that the fossil record reveals apparently abundant evidence for stasis. Debate on this topic continues, but taken at face value, stasis may suggest the operation of stabilising selection, which was a novel and exciting concept when Eldredge and Gould first presented their work. I was also disappointed to see little discussion of topics such as species selection (an example of macroevolution sensu many paleontologists), which describes putative selection of traits, such as geographic range, that are emergent at the species level rather than individual level.

Chapter 4 examines developments in evolutionary thinking since Darwin, including the 'Modern Synthesis', this being the integration of genetics with Darwinian evolution by natural selection that occurred in the first half of the twentieth century. This chapter also covers diverse topics such as the structure and functioning of RNA, DNA and proteins, and

DNA/RNA coding errors. I enjoyed the discussion on the origins of life; I am familiar with the high versus low temperature debate, but I had not previously seen this question framed in the context of entropy. I'm afraid that Figure 4.1 conveyed nothing to me.

Chapter 5 considers a topic close to our hearts: the evolution of humans. The writing focuses on two questions. First, Penny considers Descartes' separation of physical and 'mind' (body and soul, if you prefer)—could normal mutations lead to humans and, in particular, to language? Unsurprisingly, following engaging discussion, the book finds that there is nothing in human language that could not be derived by normal mutations. As I write these words, I am quite comfortable with this conclusion. Secondly, Penny focuses on the out-of-Africa versus multiregional models of human origins. Some of the writing here is a bit convoluted and I struggled to follow the argument in places (e.g. the paragraph spanning pp. 126–127). Also, I was intrigued by the comment (p. 129) that genetic interchange between modern Europeans and Neanderthals may relate to endemic diseases—it would be good to have just a little more explanation of this.

Extinction of the non-avian dinosaurs is the main topic of chapter 6. This extinction is widely attributed to a massive asteroid impact 66 million years ago, but Penny argues that this idea is 'probably wrong'. For comparison, the chapter also considers another major extinction event, the 'megafaunal extinction' of large mammals and birds that occurred over the past 50,000 years or so. Like Penny, I suspect that the causes of dinosaur extinction are more nuanced and complex than generally portrayed. To some extent, however, in this chapter he is straying from his core skills into the domains of geology and paleontology, and I found some of his arguments slightly misleading or superficial. In general, I think that he is unduly harsh in judging the widespread acceptance of the impact hypothesis; science employs parsimony, and in the face of overwhelming evidence for a large asteroid impact, it seems parsimonious to accept that this impact played a major role in the coincident extinction of the dinosaurs. Such niggles aside, I fully endorse Penny's arguing for possible multi-causes of such extinctions, and for rigorous testing of each hypothesis. In places, poor use of language might obscure his message: for example, in reference to the proposed new geological epoch, the Anthropocene, Penny asks 'whether this is the first time a new species or group of species have led to the recognition of a new geological period?' (p. 134). More precision is required here: all divisions of the geological timescale (for the past 540 million years) have been defined by changes in fossil species. The important point about the Anthropocene is not whether humans recognise a new interval of geological time, it is the fact that humans are so altering Earth systems that we have driven a planetary-scale signal in the geological record. As an aside, in chapter 6 I noted increasing incidence of the words 'evolutionary progress'—I think that the use of 'progress' in reference to evolution is a slippery slope and misleading when considering a process that is, at its heart, stochastic and contingent.

Chapter 7 of *Evolution Now* considers the early evolution of life in more detail, and focuses on the question of whether eukaryotes (cells with a nucleus) or akaryotes (cells without a nucleus) evolved first. Again, I was largely unaware of the details of this debate, and so much of the information in this chapter was new to me. The arguments are complex; I guess that much of the devil is in the detail, and unfortunately I found some of the discussion a bit opaque. In part, this is because Penny assumes too much knowledge for a non-specialist audience and, for me at least, more and simpler explanation is required. A single example is illustrative: in Figure 7.3 it is really not clear what the line diagrams show, or how they relate to the text in the caption.

Finally, chapter 8 catalogues a series of outstanding questions about evolution that remain to be answered. Some of these questions are spectacular in their aspiration: for example, to predict how any given mutation might alter an organism. Others are somewhat more prosaic, but still important: the definition of species and speciation. As a paleontologist, this latter question is always at the back of my mind as I interpret morphological variation in the fossil record. The last paragraph of the book is a wonderful, optimistic and inspiring conclusion—Penny invokes a future of cooperation and discovery, of continued evolution that may be increasingly human-directed. Such sentiments deserve to motivate a new generation of biologists—something that David Penny has done throughout his career.

Evolution Now is an idiosyncratic, quirky and very personal account. It enters a crowded field—popular books on evolution—and other texts on the topic may be more systematic and user friendly, but I enjoyed reading Penny's book and learnt a lot. It is written in a conversational style that is, in places, charming and easy reading, and in other places slightly too casual for my tastes. The book would have benefitted greatly from the attentions of an independent editor, to remove repetitions, impose uniform standards of explanation, minimise non sequiturs, remove many typos, polish the prose and remove most of the exclamation marks! Although it seems that the book is aimed at a non-scientific audience—and much of it will reach that audience—I fear that widely varying levels of assumed knowledge will hinder communication in places. For example, equivalence of 'the 1500s' and 'the sixteenth century' is explained repeatedly in chapter 1, whereas concepts such as the 'Red Queen hypothesis' (p. 32), 'epigenetics' (p. 91) and 'Markov models' (p. 169), amongst many other terms, are introduced with little or no explanation and will mean nothing to the non-specialist. (The important concept of epigenetics is discussed later, on pp. 99–100, but in a rather dense and opaque way. A simple, clear definition of epigenetic change is lacking: epigenetics refers to heritable changes in gene expression that do not involve changes to the DNA.) On a related note, there are many non sequiturs that risk confusing the reader. For example, mention of *Equus* (horses and their kin) seems out-of-place in the discussion of human evolution (p. 41). Likewise, the logical link between lateral gene transfer in bacteria and adaptation in small populations of animals (p. 67) is unclear to me. Admittedly, such instances may reflect the speed of Penny's thought processes compared to mine, but I suspect that some other readers will also struggle to make the connections.

In conclusion, the concept of evolution is, without question, one of just a small handful of scientific ideas that have fundamentally changed human understanding of our place in the universe; I believe that every house should own a book on the topic which should have pride of place on the bookshelf. With this in mind, *Evolution Now* is possibly not the first popular account on evolution that you should read or own. It is, however, an enlightening and entertaining tour through the thinking of one of New Zealand's great evolutionary scientists. The book lays out key steps along the path to our modern understanding of evolution, looks at some big picture stories that are emerging in the field and identifies major questions that remain. Although lack of editorial oversight detracts somewhat from the finished text, I enjoyed reading it and learnt a great deal. At the end of the day, this last point is probably all that matters; thank you David.

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